CLAIMS

1. A method of generating a source of metallic vapor for a material processing operation, comprising:

heating an inert carrier gas;

vaporizing a metallic element or metallic element salt in the presence of the heated inert carrier gas; and

transporting the vaporized metallic element or salt in the heated inert carrier gas to a temperature-controlled processing chamber.

2. The method of claim 1, further comprising depositing the vaporized metallic element or salt on a substrate in the chamber.

3. The method of claim 1, wherein the carrier gas is heated to a temperature at which the vapor pressure of the metallic element or salt of at least 0.01 mTorr.

4. The method of claim 1, wherein the carrier gas is heated to a temperature at which the vapor pressure of the metallic element or salt of at least 5 mTorr.

5. The method of claim 3, wherein the carrier gas is heated to a temperature between about 100 and 1000°C.

6. The method of claim 3, wherein the processing chamber is heated to about the same temperature as the carrier gas.

7. The method of claim 1, wherein the chamber is heated at least in part by resistive heating elements in or on the chamber walls.

8. The method of claim 1, wherein the inert carrier gas is Ar.

9. The method of claim 7, wherein the metallic element or salt is selected from the group consisting of alkaline earth metals and transition metals with vapor pressures greater than 0.01 mTorr at temperatures below 1000°C, and salts thereof.

10. The method of claim 2, wherein the substrate is cooled to a temperature below the temperature of the carrier gas.

11. The method of claim 2, wherein the substrate is cooled to a temperature below the vaporization temperature of the vaporized metal or salt.

12. The method of claim 10, wherein the substrate is cooled by being in contact with a cooled platform.

13. The method of claim 2, wherein the metallic element or salt is selected from the group consisting of Ca, Sr, Ba, Mn, Cd, Zn, $CaCl_2$, $CaBr_2$, $NbCl_5$ and $ZrCl_4$.

14. The method of claim 13, wherein the substrate is a material selected from the group consisting of silicon, SiO_2, ZnO and HfO_2.

15. The method of claim 14, wherein the metallic element or salt is Ca and the substrate is SiO_2.

16. The method of claim 15, wherein the carrier gas and processing chamber are heated to a temperature of about 780°C.

17. The method of claim 16, wherein the substrate is at a temperature of no more than about 400°C.

18. The method of claim 2, wherein the deposition is controlled by adjusting the vapor pressure of the element and a combination of the carrier gas pressure and flow rate.

19. An apparatus for applying a vaporized metal or metal salt to a substrate, comprising:

a carrier gas heating chamber configured to heat an inert carrier gas to a temperature in the range of 100 to 1000°C;

a vaporizer chamber, connected with the carrier gas heating chamber, and configured to vaporize a metallic element in the presence of the inert carrier gas heated in the carrier gas heating chamber; and

a deposition chamber connected with the vaporizer chamber, configured to deposit the vaporized metallic element onto a substrate, the deposition chamber comprising,

a substrate holder, and

surfaces heated to prevent deposition of the vaporized metallic element thereon.

20. The apparatus of claim 19, wherein the deposition chamber surfaces contain or contact resistive heating elements.

21. The apparatus of claim 20, wherein the substrate holder comprising cooling apparatus.

22. The apparatus of claim 21, wherein the substrate holder is water cooled.